

A Comprehensive Survey on Pretrained Foundation Models: A History from BERT to ChatGPT

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Abstract

Pretrained Foundation Models (PFMs) are regarded as the foundation for various downstream tasks with different data modalities. A PFM (e.g., BERT, ChatGPT, and GPT-4) is trained on large-scale data which provides a reasonable parameter initialization for a wide range of downstream applications. BERT learns bidirectional encoder representations from Transformers, which are trained on large datasets as contextual language models. Similarly, the generative pretrained transformer (GPT) method employs Transformers as the feature extractor and is trained using an autoregressive paradigm on large datasets. Recently, ChatGPT shows promising success on large language models, which applies an autoregressive language model with zero shot or few shot prompting. The remarkable achievements of PFM have brought significant breakthroughs to various fields of AI. Numerous studies have proposed different methods, raising the demand for an updated survey. This study provides a comprehensive review of recent research advancements, challenges, and opportunities for PFMs in text, image, graph, as well as other data modalities. The review covers the basic components and existing pretraining methods used in natural language processing, computer vision, and graph learning. Additionally, it explores advanced PFMs used for different data modalities and unified PFMs that consider data quality and quantity. The review also discusses research related to the fundamentals of PFMs, such as model efficiency and compression, security, and privacy. Finally, the study provides key implications, future research directions, challenges, and open problems in the field of PFMs. Overall, this survey aims to shed light on the research of the PFMs on scalability, security, logical reasoning ability, cross-domain learning ability, and the user-friendly interactive ability for artificial general intelligence.